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Philosophy of Science: A Personal Peek into the Future

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Abstract: In this opinion piece, the authors offer their personal and idiosyncratic views of the future of the philosophy of science, focusing on its relationship with the history of science and metaphysics, respectively. With regard to the former, they suggest that the Kantian tradition might be drawn upon both to render the history and philosophy of science more relevant to philosophy as a whole and to overcome the challenges posed by naturalism. When it comes to the latter, they suggest both that metaphysics has much to learn from the philosophy of science and that it offers an array of tools that philosophers of science can themselves appropriate.

Keywords: Kant; metaphysics; philosophy of science.

Philosophy of science is entering a new exciting era. As the editors of the *British Journal for the Philosophy of Science* (*BJPS*), we witness an enlarged horizon of topics, areas, and buzzing interactions between philosophy and the sciences that the founders of the journal, back in 1950, could not possibly have dreamt of. While the programmatic intent of the journal in the original Editorial was to explore “the whole range of science—physical, biological, and psychological” and take “science, both past and present . . . as the primary datum for consideration” (*BJPS* 1950, 3 and 4), it would have been hard to predict how—some sixty-three years later—the complex dynamics between philosophy and science would have radically changed the landscape of the subject area. From foundational studies of physics, to evolutionary developmental biology; from neuroimaging and evolutionary psychology to causal decision theories and signalling games: these are just a few of the many faces of contemporary philosophy of science. The field has expanded in myriad directions, and has engaged in serious conversation with the sciences at large, following the naturalistic trend of the second half of the last century. We could never do justice to the complexity of the current panorama, and do not even attempt in what follows to provide an overview of the many intricate and alluring topics and subfields on which we have the honour of publishing. The interested reader is kindly referred to the table of contents of any issue of the *BJPS* for that.

Instead, given the aim and scope of the present contribution as an opinion piece, we have decided to follow a more familiar path in providing two personal, inevitably incomplete, and unashamedly idiosyncratic views of how we see the field evolving. The views are personal as they reflect our respective personal research interests in the field as authors, before being editors (and, in fact, quite independently of our role

as editors of the *BJPS*). They are inevitably incomplete, as the short remarks here below cannot possibly do justice even to the two chosen trends (history and philosophy of science [HPS] and metaphysics of science) on which we have decided to concentrate. They are finally unashamedly idiosyncratic, because they reflect our individual take on each of these two fields. In what follows, we take a look in turn at HPS and the metaphysics of science, as just two families inhabiting the many-storeyed house of contemporary philosophy of science. Although the limited selection of subfields preempts any temptation to draw grand conclusions about the future of philosophy of science, we hope that what follows may serve as a spring-board for wider reflections on how each of these two areas has affected the remit of philosophy of science as a whole, and is bound to shape (at least in part) its future.

A New Era for History and Philosophy of Science

When it comes to new directions in the vast field of philosophy of science, it is hard not to mention the recent revival of the trend that goes under the name of HPS, or history and philosophy of science. Since both of us work on and have made contributions to HPS, we have chosen it as our first paradigmatic example of future directions in philosophy of science, with an important caveat. Once more, the following reflections on the status of HPS and its future are just personal considerations from the point of view of our own work in the field. They are not intended to be reflections about *BJPS publishing* policy or editorial directions.¹

Caveat aside, there is no doubt that recent times have witnessed a very productive and renewed interaction between philosophy of science and history of science. Far from being a remnant of foregone times, when the likes of Popper, Lakatos, Kuhn, and Feyerabend set out HPS as a distinctive discipline, contemporary philosophy of science has explored promising new ways of drawing on the history of science to illuminate both old and new philosophical problems. Be it foundational issues about spacetime theories (see, e.g., Norton 1985, 2000, 2008; and Howard 1985, 2010) or the science of measurement or metrology (Chang 2004; Tal 2011; Teller 2013); be it realism and anti-realism about science (Giere 2006; Stanford 2006; van Fraassen 2008), or the nature of scientific theories and models (Morrison 2000); be it biological complexity (Mitchell 2009) or the evolution of physical concepts (Arabatzis 2006), the many faces of contemporary HPS show how thriving the field is. A new national and international movement, called Integrated HPS, to which both of us have actively contributed since its foundation back in 2006, provide annual national and biennial international gatherings where the state of the art in the field is presented. The programmatic manifesto recommends more than just the Lakatosian dictum of a historically informed philosophy of science on pain of philosophy of science being empty. Good HPS is not philosophy of science with interspersed case studies. Instead, it is both good philosophy of science and good history of science. It is philosophy of science that brings history of science to the fore and genuinely draws on it, without any preconceived philosophical agenda.

In some philosophical quarters, noses turn up at the idea of philosophy of science drawing on the history of science. For surely the normative role of philosophy would, appear to some to be impoverished by renewed attention to the history of science. Prejudices aside, two challenges stand on the way of HPS as a promising direction of research:

I. *Disciplinary enclaving*: we are using a strong word here to convey the perceived uneasiness felt in

¹ *BJPS* publishes first-rate articles in HPS, among many other areas, although HPS does not constitute the distinctive remit of the journal, by contrast with *Studies in History and Philosophy of Science* (A, B, and C), among other journals.

some HPS quarters of working in isolation from the broader philosophy community, as testified by the low presence of HPS papers at the meetings of several main philosophical societies, for example. What good is HPS to philosophy, in general?

II. *Naturalism*, or when a virtue may become a vice: that philosophical inquiry should be continuous with science is a hard-to-resist tenet after Quine. That philosophy of science should engage with the details of actual scientific practice is also a sine qua non of any credible inquiry into science and its modes of inquiry. But how to walk the thin line between philosophy and the sciences?

The two challenges seem to be pulling HPS in opposite directions. Any serious attempt to bridge the gap with philosophy seems *prima facie* to force HPS away from its naturalistic leanings; as much as following those leanings risks transforming HPS into a series of scientific case studies. In what follows, we selectively look at a possible (by no means exclusive) way of addressing these two challenges in contemporary HPS, namely, “dynamic Kantianism.”

How to Bridge the Gap Between HPS and Philosophy: The “Back to Kant” Recipe

There is something *prima facie* surprising about the recent revival of Kantianism in HPS. For surely nothing would seem more remote from contemporary scientific practice than Kant’s outmoded view of natural science. Why hark back to Kant and neo-Kantianism in our post- Euclidean and post-Newtonian world? (See Wilson 2010.) How could Kant’s philosophy ever illuminate the nature of contemporary physics without mentioning biology or cognitive sciences? The ideas of apodeictic certainty and necessity, which formed the bedrock of Kant’s program, were long ago discarded.

Yet there is some profound insight in the Kantian tradition that contemporary HPS can still draw on. And this is the idea that the problem of knowledge, of how we come to know what we do, should be addressed by looking at the natural sciences and at the specific ways in which knowledge of the natural world is gained in the first instance. Two centuries after Kant in the *Prolegomena* raised the question “How is natural science possible?” contemporary HPS scholars find themselves asking similar questions. How is it possible for us to have the experience of nature delivered by contemporary science? How has our experience of nature changed over time and across scientific revolutions, with the advent of, say, relativity theory and quantum mechanics? Most important of all, in our post-Kuhnian world, how could these transitions occur? Following the well-trodden path of neo-Kantianism at the turn of the last century, contemporary HPS scholars can pursue these questions with an eye both towards the broader epistemological framework within which they arise and towards history of science and history of philosophy of science.

HPS inquiry, then, does not reduce to a mere investigation into the methodology of science. But it becomes continuous with epistemology, or with what the Marburg School called *Erkenntnistheorie*, while also fruitfully drawing on the rich and complex details of scientific history. In the past two decades, Michael Friedman (1992, 1999, 2001, 2010) has shed new light on the importance of this philosophical tradition for contemporary HPS, and beautifully exemplified (in our view) a possible way in which HPS can avoid the aforementioned disciplinary enclaving. “Dynamic Kantianism,” as Friedman brands his view, shows the good that comes from embedding the practice of history and philosophy of science within epistemology (broadly construed). And it has opened up promising new avenues of research, both for a serious re-appraisal of the historical and philosophical foundations of physics (see, e.g., Ryckman 2005, 2012) and for the vast area that goes under the name of history of philosophy of science (HOPOS), whereby the history of the discipline can

provide precious insights into the epistemological foundations of HPS (regardless of whether one embraces dynamic Kantianism; see, e.g., Richardson 1998, 2002).

How to Walk the Thin Line Between Philosophy and Science: The “Back to Kant” Recipe, Again

But, one may wonder, how can Kantianism help with the challenge of naturalism mentioned above? If anything, the naturalistic trend in the philosophy of science of the past fifty years originated as a reaction to Kantianism. Quine’s naturalism was the last straw that put to an end any attempt to defend not only Kant’s distinction between analytic and synthetic knowledge but also Carnap’s *Aufbau* (rooted as it was in the Kantian tradition; see Friedman 1999). At the same time, Thomas Kuhn’s (1962) new agenda for HPS cemented what Kitcher (1992) has poignantly portrayed as a form of “radical naturalism,” which was bound to make philosophy of science a chapter of history of science, or, after Kuhn, a chapter of sociology of science or science studies. By reacting to the logical empiricist tradition that he saw still exemplified by Carl Gustav Hempel, Kuhn rediscovered the central role that history of science plays for philosophical questions about the structure of scientific revolutions and the nature of theory-choice.

The healthy naturalistic trend of the past half century enjoins philosophers of science to dig into the details of actual scientific practice as much as it enjoins HPS scholars to plunge into the details of scientific history. We witness this healthy naturalistic trend in the *BJPS* publishing tradition, where first-rate work in contemporary philosophy of science comes from a serious engagement with scientific practice. New exciting research on neuroimaging being used to illuminate old philosophical questions about theories of mind; detailed analyses of modelling practices bearing on pressing questions about climate change; population genetics models questioning perennial issues about the nature of selection: these are just three examples of how contemporary philosophy of science has flourished under the naturalistic trend. In the HPS tradition, the naturalistic trend is in turn reflected in a serious engagement with the sciences of the past; and not just with textual evidence but also with past experimental traditions and the conceptual resources made available by them, in order to understand what images of nature were in fact accessible to the scientists of the past.

The worry—as always—is how to walk the thin line that separates philosophy from science (past and present). Or better, how to draw from the (past and present) sciences in a philosophically compelling way, rather than leaving the sciences to speak for themselves, as it were. This is not the place to rehearse the old dispute whether philosophy (in this case, philosophy of science) should or should not have a normative role. Instead, what is at stake is the nature of the fruitful interaction between science, on the one hand, and both philosophy of science and HPS, on the other hand, as a two-way (rather than one-way) street. Scientific practice (past or present) should inform philosophical inquiry, as much as the latter can and should throw light on the former via its own rules and investigative methods.

The “back to Kant” recipe, once again, may help here. Kant’s philosophy of natural science was informed by the sciences of his time, as much as it was meant to illuminate their foundations by its own philosophical lights. Dynamic Kantianism no longer invokes a priori categories of the understanding or pure forms of intuitions, it instead takes the lead from logical empiricism (especially Carnap and Reichenbach) to provide a new spin on Kant’s old notion of “constitutive a priori,” as it may still be applicable to contemporary physics with all due provisos (see Friedman 2001 and 2010). Friedman’s notion of “relativized constitutive a priori” is at the centre of an ongoing debate, as many HPS scholars would firmly resist both its Kantian spirit and its applicability to modern physics. But in our view, the merit of this trend consists in having shed new light on the role of our scientific history both for philosophy of science and, more broadly, for epistemology. Within this tradition, Newton and Einstein become philosophical figures in their own right,

whose scientific work integrates into and illuminates the very epistemological foundations of science. This is just one of the many ways (and obviously not an exclusive one) in which the challenge of naturalism can be satisfactorily met. It certainly does so with an eye towards philosophy, more in general; accordingly, it is an enticing way of addressing both aforementioned challenges.

If the aforementioned interaction between philosophy of science, epistemology, and history of science constitutes in our view a promising frontier in the field, another prominent one is characterized by the interaction between science, philosophy of science, and metaphysics. There is now a growing appreciation that the often fraught relationship with contemporary metaphysics might be improved, to the benefit of both metaphysicians and philosophers of science. It is to this renewed interest in the metaphysics of science that we turn next.

Building Bridges Between Metaphysics and Philosophy of Science

From the perspective of the history of the philosophy of science over the past one hundred years or so, the relationship with metaphysics has been at best an uneasy one. Dismissed by the positivists as sterile and useless, and more recently as a dead intellectual pursuit, metaphysics has been further excoriated as reliant on simplistic intuitions or, at best, school yard science (Ladyman and Ross 2007). Nevertheless, that it should be perceived as having drifted so far from any mooring in physics is surprising, first, given the way its heroes—here the likes of Putnam and Quine in particular come to mind—drew on the physics of the day, secondly, given the way in which today's practitioners model their meta-metaphysical moves on what they see as the methodology of the sciences—appealing to simplicity, explanatory power, and the like—and thirdly, and perhaps most significantly, given the widely held commitment to some form of physicalism. Perhaps the answer lies in the move to the modal, so characteristic of modern metaphysics, as a result of which the latter is now seen as primarily concerned with the possible, rather than the actual (Callender, 2011). Given the size of possibility space and the fact that actuality occupies such a small fragment of it, is it any wonder—this line of speculation goes—that metaphysicians would prefer to roam the vast reaches of the former rather than get to grips with the grubby intricacies of the latter?

Of course, if the limits of possibility are delineated by what is conceivable, the actual may appear dwarfed by all the possibilities. Conceivability figures prominently in philosophical discussions of the epistemology of modality (for a useful introduction see <http://plato.stanford.edu/entries/modality-epistemology/>). Broadly speaking, success in conceiving of some claim, concept, or, indeed, world is taken to support (or even entail) that the claim, concept, or world is possible. The nature of conceiving, whether it is equivalent to imagining or goes beyond imagining, the extent to which it involves construction and the nature of such construction loom large in these discussions. In particular, if conceivability is strongly tied to imaginability, then one might demand general conditions governing the latter, such that imagining a world or situation is sufficient to provide evidence for the possibility of such a situation. In the absence of such conditions, one should at least acknowledge that conceivability is defeasible, in the sense that one may not be aware of some consideration that undermines the relevant evidential link (Yablo 1993). Black's two-sphere counterexample to the Identity of Indiscernibles appears to fit this model quite nicely, as Hacking (1975) effectively drew on considerations from physics (specifically General Relativity) to show that what Black had conceived was not sufficiently fine-grained to serve as a relevant possibility.

Of course, even if no such consideration is immediately apparent, it may still be "out there," as it were, and hence one might insist that all but the most simple conceptions should be held as potentially defeasible. One can even imagine, or conceive of (!), a kind of spectrum, beginning with *prima facie* conceivability, in which one simply conceives of or imagines a situation without thinking further about it,

moving into better thought out conceivability, in which the relevant situation becomes more fine-grained, and, perhaps, the evidential connection decreases in defeasibility, until one comes to some form of fully constrained conceivability, where no further fine-graining is possible, and the link to possibility is indefeasible because the possible world is constrained by the relevant physics.

Many, perhaps most, metaphysicians are still hanging out at the far end of the spectrum, where conceivability is, if not unconstrained, then limited only by intuition or broad metaphysical principles. But attitudes appear to be shifting. In recent years there have been a number of conferences and workshops bringing together philosophers of science, scientists, and metaphysicians and resulting in associated special issues and collections. More metaphysicians are beginning to engage seriously with physics, whether via a consideration of the implications of relativity theory for issues of persistence or via the incorporation of non-supervenient quantum relations in bundle theoretic accounts of objects. Here, then, there are welcome signs of new bridges being built as well as old connections being used in new ways.

But more than this, there is growing awareness that in their exploration of the space of possibilities metaphysicians have developed various sets of tools that might then be appropriated and usefully employed by philosophers of science (French and McKenzie 2012). These include not only comparatively well-known concepts such as supervenience and dependence but also general strategies, manoeuvres, or metaphysical moves in general. Thus, Teller long ago appropriated the concept of supervenience for the philosophy of science and employed it to articulate a view of quantum entanglement as involving non-supervenient relations (Teller 1986). Notions of dependence of course feature prominently in discussion of causation but have recently been applied to consideration of the relationship between numbers, say, and mathematical structures (Linnebo 2008) or between elementary particles and the symmetries of the Standard Model (McKenzie forthcoming). Moving to the more general level of argumentative strategies and manoeuvres, it is interesting to consider how eliminativism in physics, for example, might be supported by the moves deployed by metaphysical monists and nihilists elsewhere. Thus Horgan and Potrč (2008) have defended a monistic ontology—there is only one thing, called (with tongue in cheek) “the blob”—by invoking a distinction between truth as direct and as indirect correspondence, with the latter articulated in terms of contextually understood semantic standards. Cameron (2008), on the other hand, offers an alternative form of truth-maker theory, in which the truth of sentences referring to putative entities is grounded in something other than those entities.

So, to take a well-known example from the history of science, the truth of statements made by Eddington about his table can, on Cameron’s account, be grounded in the relevant elementary particles “arranged table-wise.” Now the sense in which such particles can be regarded as the metaphysicians’ infamous “simples,” and also the sense in which we are supposed to understand “arrangement” in this context, remain contentious, and here there is a need for further to-and-fro traffic across the metaphysical bridge. But the point is that there are potentially useful sets of tools in the metaphysicians’ toolbox that philosophers of science might avail themselves of and deploy. Of course, this raises further issues, such as how tools developed far away in possibility space, as it were, can be of any use in understanding science as developed in this, the actual, world, or whether the use of such tools puts the philosophy of science in tension with the naturalistic tendency that is currently prominent. If, however, we accept that the philosophy of science has to achieve an appropriate balance between, on the one hand, drawing on both the practice and the history of science, as indicated above, and, on the other hand, articulating an account or view of science that is more than just a series of case studies and that involves the deployment of the kinds of tools just outlined, then these issues cannot be avoided.

Conclusion

As we indicated, this is a very personal view of potentially fruitful developments in two selected areas of contemporary philosophy of science. As well as exciting new work in the philosophy of particular sciences, especially philosophy of the bio-medical sciences and neurosciences, some of the standard topics still have the capacity to generate interesting lines of inquiry: the role of mathematics in science, for example, particularly its role in explanation; decision theory and reasoning under uncertainty in general; and the nature of scientific representation, where useful connections have been drawn with the philosophy of art, just to name a few. Even the realism-antirealism debate, which for some may appear stagnant as the various combatants remain locked in their respective positions, shows signs of renewed vigour as, for example, the role of case studies in propping up such positions is re-examined. Some years ago an elder statesman patiently explained to one of us that the philosophy of science was moribund and doomed to shrink and fade as its original impetus lost steam. In fact, the field seems more alive with ideas and exciting developments than ever, as it engages both with science itself and with philosophy more broadly. As editors, we are proud to be a part of this venerable tradition that has published, and will continue to publish, the very best results of these developments in the pages of the *BJPS*.

References

- Arabatzis, T. 2006. *Representing Electrons: A Biographical Approach to Theoretical Entities*. Chicago: University of Chicago Press.
- BJPS*. 1950. "Foreword." *British Journal for the Philosophy of Science* 1:1–4
- Callender, C. 2011. "Philosophy of Science and Metaphysics." In *Continuum Companion to the Philosophy of Science*, edited by S. French and J. Saatsi, 33–54 London: Continuum Press.
- Cameron, R. 2008. "Truthmakers and Ontological Commitment: Or How to Deal with Complex Objects and Mathematical Ontology Without Getting into Trouble." *Philosophical Studies* 140:1–18.
- Chang, H. 2004. *Inventing Temperature*. Oxford: Oxford University Press.
- French, S., and K. McKenzie. 2012. "Thinking Outside the (Tool)Box: Towards a More Productive Engagement Between Metaphysics and Philosophy of Physics." *European Journal of Analytic Philosophy* 8:42– 59.
- Friedman, M. 1992. *Kant and the Exact Sciences*. Cambridge, Mass.: Harvard University Press.
- 1999. *Reconsidering Logical Positivism*. Cambridge: Cambridge University Press.
- 2001. *The Dynamics of Reason*. Stanford: CSLI Publications. . 2010. "Synthetic History Reconsidered." In *Discourse on a New Method: Reinvigorating the Marriage of History and Philosophy of Science*, edited by M. Domski and M. Dickson, 571–814. LaSalle: Open Court.
- Giere, R. 2006. *Scientific Perspectivism*. Chicago: University of Chicago Press.
- Hacking, I. 1975. "The Identity of Indiscernibles." *Journal of Philosophy* 72:249–56.
- Horgan, T., and M. Potrč. 2008. *Austere Realism*. Cambridge, Mass.: MIT Press.
- Howard, D. 1985. "Einstein on Locality and Separability." *Studies in History and Philosophy of Science* 16:171–201.
- 2010. "Let Me Briefly Indicate Why I Do Not Find This Standpoint Natural: Einstein, Relativity, and the Contingent A Priori." In *Discourse on a New Method. Reinvigorating the Marriage of History and Philosophy of Science*, edited by M. Domski and M. Dickson, 333–56. LaSalle: Open Court.
- Kitcher, P. 1992. "The Naturalists Return." *Philosophical Review* 101:53– 114.
- Kuhn, T. S. 1962. *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press.
- Ladyman, J., and D. Ross. 2007. *Everything Must Go: Metaphysics Naturalized*. Oxford: Oxford University

Press.

- Linnebo, Ø. 2008. "Structuralism and the Notion of Dependence." *Philosophical Quarterly* 58:59–79.
- McKenzie, K. Forthcoming. "Priority and Particle Physics: Ontic Structural Realism as a Fundamentality Thesis." *British Journal for the Philosophy of Science*.
- Mitchell, S. 2009. *Unsimple Truths: Science, Complexity, and Policy*. Chicago: University of Chicago Press.
- Morrison, M. 2000. *Unifying Scientific Theories: Physical Concepts and Mathematical Structures*. Cambridge: Cambridge University Press.
- Norton, J. 1985. "What Was Einstein's Principle of Equivalence?" *Studies in the History and Philosophy of Science* 16:203–46.
- 2000. "'Nature in the Realization of the Simplest Conceivable Mathematical Ideas': Einstein and the Canon of Mathematical Simplicity." *Studies in History and Philosophy of Modern Physics* 31: 135–70.
- 2008. "Why Constructive Relativity Fails." *British Journal for the Philosophy of Science* 59:821–34.
- Richardson, A. 1998. *Carnap's Construction of the World: The Aufbau and the Emergence of Logical Empiricism*. Cambridge: Cambridge University Press.
- 2002. "Narrating the History of Reason Itself: Friedman, Kuhn, and the Constitutive A Priori for the Twenty-first Century." *Perspectives on Science* 10:253–74.
- Ryckman, T. 2005. *The Reign of Relativity*. Oxford: Oxford University Press.
- 2012. "What Does History Matter to Philosophy of Physics?" *Journal of the Philosophy of History* 5:496–512.
- Stanford, K. 2006. *Exceeding Our Grasp: Science, History and the Problem of Unconceived Alternatives*. Oxford: Oxford University Press.
- Tal, E. 2011. "How Accurate Is the Standard Second?" *Philosophy of Science* 78:1082–96.
- Teller, P. 1986. "Relational Holism and Quantum Mechanics." *British Journal for the Philosophy of Science* 37:71–81.
- 2013. "The Concept of Measurement-precision." *Synthese* 190:189–202.
- van Fraassen, B. 2008. *Scientific Representation: Paradoxes of Perspective*. Oxford: Oxford University Press.
- Wilson, M. 2010. "Back to 'Back to Kant.'" In *Discourse on a New Method: Reinvigorating the Marriage of History and Philosophy of Science*, edited by M. Domski and M. Dickson, 553–68. LaSalle: Open Court.
- Yablo, S. 1993. "Is Conceivability a Guide to Possibility?" *Philosophy and Phenomenological Research* 53:1–42.